THE EFFECT OF ORDER OF PRESENTATION ON THE PROGRAMMED LEARNING OF BRAILLE

H. K. Russell, 1970

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THE EFFECT OF ORDER OF PRESENTATION ON THE PROGRAMMED LEARNING OF BRAILLE

By

HARRY KENNETH RUSSELL

A thesis submitted in partial fulfillment of the
requirements for the degree of

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WASHINGTON STATE UNIVERSITY
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The members of the Committee appointed to examine the thesis of HARRY KENNETH RUSSELL find it satisfactory as to content and form and recommend that it be accepted.

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THE EFFECT OF ORDER OF PRESENTATION ON THE PROGRAMMED LEARNING OF BRAILLE

ABSTRACT

By Harry Kenneth Russell, Ph.D.
Washington State University, 1970

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The continued expansion of the visual modality for information processing has particularly handicapped those individuals with the loss of this sense. The advent of the programmed machine and the use of programmed learning techniques as a method of teaching, offers a valuable potential for the blind who must rely on Braille as a means of information input. Since serious efforts are currently underway to make Braille even more accessible to the blind, it was considered important to investigate some of the variables that contributed to the learning of a skill in general, and Braille in particular.

This paper primarily concerns itself with the effects of various orders of presentation of the tactually experienced Braille character and its auditory explanation as it might be presented in some machine programmed method of instruction. Three orders were presented. The first temporal arrangement considered was similar to that found in classical conditioning experiments in which Stimulus 1 (the Braille character) precedes

Stimulus 2 (the auditory explanation) by a short interval. The second condition required that both stimuli be presented simultaneously; and the third order of presentation was a reversal of the first, in which Stimulus 1 followed Stimulus 2 after a short interval. One additional condition was utilized in which Stimulus 1 was presented with the absence of Stimulus 2. This was a control condition to insure equal tactual familiarity.

Analysis of the results suggested a trend, although not significant, favoring short forward conditioning.

There were no differences between the groups in their ability to retain the Braille material over a 24-hour period, suggesting that once a skill is acquired to a certain criterion, ability to retain the skill is constant over subjects.

The Roughness Discrimination Test (RDT) was used to see if it had any predictive ability with non-blind, normal subjects. It was not able to predict ability to learn Braille with a population of prison inmates.

Intelligence, as expected, and as defined by the Army General Classification Test (AGCT) appeared to have a positive relationship to learning Braille. This also held true with education level.

An attempt was made to relate various personality characteristics, as defined by the Minnesota Multiphasic Personality Inventory (MMPI), with other demographic variables as well as the learning variables. Some relationships were significant although a more exact explanation must wait for further experimentation.

There is little doubt that the need for Braille skill will continue to increase and as more and more of the non-Braille reading blind population seek instruction in this skill, automatic, programmed machines will be needed to keep up with the demand. Continued research in this area is imperative if we are to meet the needs that currently exist and which are projected for the future.

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CHAPTER I

INTRODUCTION

Information assimilation, in an era of rapid technological and socio-cultural change, has become mandatory in order for one to effect even a marginal adjustment. The communications media have made such strides within the last decade that instantaneous contact can be made anywhere around the world and the only limit to communications beyond the earth is a function of time and noninterfering masses.

For the majority of individuals affected, the most important and significant advancement has been visual. TV pictures of man's presence on the moon, TV from space, pictures of and from the planets, represent an advancement and an experience difficult to describe in words. Consequently, those individuals with the loss of this primary modality are finding it increasingly difficult to keep abreast of these developments.

The audio-visual modalities are our primary source of information input. The loss of the visual and the availability of the auditory as a substitute—i.e., radio, sighted associates, and the talking book—leaves much to be desired. It, therefore, remains for the tactual modality and its attendant symbol system, Braille, to bear the burden of informing the totally blind about his environment and to allow him to obtain the skills necessary

for independent and productive living. In view of its importance any attempt at aiding the blind to make the most effective use of the Braille symbol system as well as to aid in the ease at which it may be acquired, must be considered very desirable.

Heber, Lang and Flanigan (1967) estimate that there is a gap of some three to four years in educational retardation among blind adolescents. They estimate that the average blind high school senior reads Braille at about 90 words per minute compared with 250 words per minute for the sighted senior and the 150 words per minute for the partially sighted large type reader. They also suggest that once the blind leave their training institutions, their use of Braille rapidly decreases. They reported that while only some 3 to 10% of the adult blind read Braille, there are some 43% who are capable of doing so. They see the lack of utilizing the Braille skills as a function of the availability of printed matter. The development of teaching devices applicable to the sighted population is well known (Fry, 1963), although the extensive use of the results of research in learning have not found their way into the normal classroom, let alone the teaching of the blind.

Various investigations have been conducted attempting to detect "differences" between blind and sighted persons in general, suggesting that the blind are set apart in more ways than their blindness. A review of this literature reflects little agreement between investigators in such important variables as how the blind tactually perceive; what additional

characteristics are important as an aid to learning; or how they are different or similar to the sighted population (Heber, et al., 1967).

The method of teaching Braille has a tendency to perpetuate itself, with the "blind leading the blind" and very little information systematically obtained as to the important variables in the teaching process. Innovation in method of instruction must succumb to the demands of service. Interest in the needs of the blind rarely extends beyond those who have directly or indirectly come into contact with blindness.

Another problem, of course, is the lack of commercial interest in the area of program media for the blind, probably because of the relatively small number of blind persons in the total population. There is one program machine currently available, used primarily for research purposes: Modern Teaching Associates, incorporated, of Milwaukee, Wisconsin have developed their MTA-100 Scholar teaching machines, which presents tactual material written in Braille synchronized with an audio sequence. This was displayed at the Illinois Council for Exceptional Children at their October, 1966, conference in Peoria, Illinois. Heber, et al. (1967) also developed a research teaching machine along the same lines and did an extensive evaluation of programmed instruction in Braille. This study can be considered a milestone--mainly because it is the only published comprehensive experimental program in the literature--in the marriage of technology and special education for the blind. Both machines allow for the subject to proceed at his own pace, with

some provisions being made for auditory feed-back or reinforcement of correct responses. The theory for this approach comes from the general field of programmed learning. Modern Teaching Associates, Incorporated, have conducted no specific research on their own to determine the best method of presentation; nor have Heber, et al., relying primarily on the literature in programmed learning for their design.

The Engineering Projects Laboratory, Department of Mechanical Engineering, Massachusetts Institute of Technology (Dupress, 1968) has been interested in applying technology for the benefit of the blind. Their particular goal has been and continues to be to increase the volume, scope and ease with which formal and informal communications are made available in Braille to persons who are blind, while at the same time reducing the time lapse in acquiring Braille copy. Under this particular program, Blanco (1968) reports the experimental development of a punched-tape-to-Braille direct and continuous mechanical transducer. This direct transducer is a machine which performs simultaneously the dual function of information retrieval and Braille display. It is designed to take perforated tape in a convenient coded form and convert it to Braille display. While still in the experimental form, it offers a reasonably inexpensive machine (below $100.00) that will take perforated tape.

Woodcock (1967) reports on a machine whose output is a perforated paper tape which is used in a paper ~~tape~~ reader to automatically operate an electric Brailler. Its purpose is to make Braille copy more available to the blind. Although some

publishing companies have produced Braille books (e.g., the Reader's Digest) their numbers are small and not easily available. Some small social service agencies and individuals have become interested in transcribing written material into Braille symbols, but, again, this number is quite small. One of the problems in the maintenance of any skill is its constant use. If the materials are not available, the skill diminishes.

Ashcroft (1961) designed a specialized text incorporating the principals of programmed instruction as used in teaching machines. The purpose of the project was to teach basic mastery in reading and writing Braille in a five-week period. In this text, the Braille code was divided into eight units for instructional purposes. After adequate mastery at each unit level was attained, as ascertained by the unit test, the next level was undertaken. Sixteen students were enrolled in a course using this text. None failed; none dropped out. Validity of the text as a teaching technique was indicated from the correlation of unit test scores with efficiency test scores (.90), and a correlation of final exam scores with preliminary test scores (.77). The correlation of the unit test scores and final exam scores equalled .73. A limiting feature of the text was that it could only be used with those who were able to read and write in print, and as such eliminated a great number of potential Braille readers.

Braille material is currently reproduced by Braille typewriters (Braillers) which produce original embossed pages and possibly one inferior quality copy; by production printing

presses using embossing metal plates; and by plastic or raised ink deposition processes which form the Braille forms by adding material rather than embossing.

Braille, reproduced at a rather slow, line-at-atime rate, is considered quite costly and the resulting texts are generally bulky and awkward when compared to the ink printed page for the sighted. Under these conditions, blind readers can find themselves at a great disadvantage with the sighted when depending upon reading material. Blind people are assuming increasingly responsible occupations in industry and the professions and there appears little doubt that the total population of blind in the United States is and will be increasing in view of the life-saving techniques currently practiced in the Viet Nam war.

The Blanco (1968) machines, and others of the same type, promise to allow for the mass production and mass reproducibility of Braille material in space saving perforated tapes. The need for Braille will be increasing as more sophisticated machines are developed for printing and displaying Braille. Teaching machines and programmed instruction appear to offer the best potential for dealing with the problem of teaching Braille rapidly, efficiently and effectively.

With this promised increased availability and reproducibility and the critical importance of Braille as the medium of communication for the blind, it becomes increasingly important that investigation be conducted into the variables in the learning process most closely related to programmed instruction.

Purpose

The purpose of this project is to investigate selected variables which might be involved in determining the most efficient and effective learning of Braille.

Traditional instruction in Braille, utilizing the blind or sighted instructor, appears to follow the procedures for skill training as suggested by Fitts (1964). In the first or cognition phase it is assumed that the subject becomes familiar with the patterning of the dots and either obtains a mental image of these patternings, as in the case of the newly blind, or arrives at some tactual gestalt. The Braille learner then proceeds to the fixation phase where he becomes more familiar with the patternings through practice, and is able to respond with less direct cognitive activity. The final stage is that of automation in which it is no longer necessary for much cognitive activity to take place.

This appears to be the basic method by which various skills, such as shorthand, typing and Morse code training are taught. For example, Bryan and Harter (1899) found that in the acquisition of skill in telegraphy, subjects learned individual letters first, then words as units and finally phrases or sentences as units.

We do not know, however, whether this type of instruction continues because of the type of material used, the traditional necessity of a live, cognitive instructor, because the method of instruction is handed down from instructor to pupils; or because this is the most effective way of acquiring

a skill of this nature. We do know, however, that when this type of training began, we did not have available for use programmed machines or material.

Skill training, as traditionally defined, has graphically been illustrated, in terms of learning curves, as a steady increase in ability, a period of little or no improvement, a sudden spurt in ability, and then a gradual leveling off to a final asymptote (Deese, 1952). This period of little or no improvement has traditionally been known as a plateau, and would occur, in Fitts' (1964) terminology, during the fixation phase.

One of the earliest studies having to do with the learning of a complex perceptual-motor skill (Bryan and Harter, 1899) reflects the progress of an operator learning to receive telegraphic code. This study graphically illustrates that period of little or no improvement.

Efforts to explain plateaus have run the gamit from cognitive reorganization to subject motivation. Hunter (1934) suggests that these plateaus might be temporary periods devoted to the organization of component habits into larger units, or to the learning of particularly difficult portions of a problem. For example, in typing, plateaus may occur when the learner is making the transition from a letter habit to a word habit. It is during this period of time that no apparent improvement occurs. Ruch (1967) suggests that this plateau may be caused by a loss of interest; or may reflect a change in the subject's

mode of attack on the problem; or may result from interference of a previously learned skill.

Keller (1958) suggests that the occurrence or non-occurrence of plateaus might depend upon the nature of the task, and the previous experience the learner has had.

However, one might also explain the occurrence of a plateau as the transition from the cognitive phase of skill learning to the stage of automation, or more specifically, in Fitts' (1964) terms, the fixation phase. If this be the case, then a method of instruction which offers a potential for skipping or greatly reducing the time involved in one or more of these phases might be considered advantageous. Programmed instruction may offer a potential in this direction.

Order of Presentation

Programmed machines currently under experimental use have provisions for both auditory and tactual feedback as well as offering mechanisms for the dispensation of concrete reinforcers. We are primarily concerned with the question of whether the order of presentation of the two stimuli--the tactually experienced Braille character (Stimulus 1) and the auditory explanation of this character (Stimulus 2)--is a critical variable and whether it might have important methodological considerations in setting up an automatic programmed system of teaching Braille.

Studies involving the time relations between stimuli or the order of presentation of the two stimuli can generally be

found in the conditioning literature. The classical conditioning literature, in particular, has concerned itself with the order of presentation of two stimuli as well as the optimum interval between the presentation of the Conditioned Stimulus to the presentation of the Unconditioned Stimulus. Four basic temporal relations, or orders in time, are generally discussed (Millenson, 1967). The first is the "simultaneous conditioning" procedures in which there is usually a one-half second or less interval between the onset of both stimuli. The second is the "delay" procedure in which Stimulus 1 is presented for some period of time, toward the end of which Stimulus 2 is presented, both of which are terminated at the same time. The third procedure has been called "trace conditioning" in which Stimulus 1 is presented, terminated and then Stimulus 2 is presented. The fourth procedure has been called "backward conditioning" in which Stimulus 2 occurs first, is terminated, and Stimulus 1 is then presented. One additional procedure has been mentioned in the literature and that is where the Stimulus 2 is presented alone periodically without Stimulus 1 at all.

All of the four basic procedures, with the exception of the so-called "backward conditioning," appear to produce learning to some degree. In these experiments, however, the definitions of Stimulus 1 and Stimulus 2 are reasonably well clarified. Stimulus 2 is generally seen as the stimulus which has already been observed to elicit a measurable response; and Stimulus 1 is fairly well defined as "some" stimulus, known not to elicit that particular response.

Which of these particular orders produces the best learning depends upon the sense modality involved, the stimuli selected and the organism considered (Hall, 1966).

However, in an early experiment investigating the inter-stimulus interval, Wolfle's (1932) results suggested that of all the various temporal arrangements possible of the Conditioned and Unconditioned Stimuli, the relationship of greatest efficiency is that where Stimulus 1 precedes Stimulus 2 by a short interval and that as the time interval between these two stimuli increases, and the temporal arrangement changes, learning decreases. Others (Bernstein, 1934; Kappauf and Schlosberg, 1937; and Reynolds, 1945), have also found that the most efficient order of presentation of the two stimuli favors short forward conditioning.

As is common in these types of experiments, the organism is not required to make an overt, voluntary response; but, rather, the response is the expected result of the experimental manipulation. Studies in this area have, by necessity, been limited to those organisms and physiological mechanisms to which a measurable response can be obtained.

Purposive behavior, that is behavior under direct control of the subject, has been investigated under an operant conditioning paradigm or under some verbal learning rubric. These differences are primarily related to the characteristics of the task and the type of material used.

Since in the operant conditioning paradigm, the organism acts upon his environment and is rewarded on the basis of this

activity, once it has been empirically determined and demonstrated which stimulus is the discriminative stimulus and which the reinforcing stimulus, the order of presentation of these two stimuli remains constant.

In verbal learning studies, both stimuli are arbitrarily defined, and in many cases, can be interchanged. For example, Underwood and Schulz (1961) constructed eight paired-associate lists, using adjectives and nonsense syllables. Four of the lists were made up in which adjectives served as stimuli (Stimulus 1) and nonsense syllables as responses (Stimulus 2), (A-S). Four other lists were constructed with nonsense syllables serving as stimuli and the adjectives as responses (S-A). Each subject learned four lists, either the A-S or the S-A. On the basis of mean total correct responses, throughout the four lists learned, the S-A group did significantly better than the A-S group. Of interest for the present study is the fact that learning did occur in each case no matter the definition of the two stimuli, and that learning is more rapid when we designate as the response the more meaningful of the two stimuli.

Cieutat, Stockwell and Noble (1958) employed nonsense syllables and three levels of meaningfulness (high, medium, and low) of stimuli and responses. In general, they found that the average difference among groups due to the meaningfulness of the response is greater than that due to the stimulus. L'Abate (1959) also found that when high meaningfulness is associated with the response member, learning is more rapid.

These results suggest that the order of presentation of two stimuli is an important consideration in learning situations involving the acquisition of verbal responses.

Tactual sensitivity

Since the tactual sense may contribute quite heavily to the general activation level of the organism, we are interested in the role this modality plays in the acquisition of Braille. Secondly, we are interested in any instrument or method which would aid in differentiating between individuals with high and low tactual sensitivity and whether a difference, if existing, can be related to the ease with which Braille may be learned.

The literature in this area has generally confined itself to attempts at detecting differences between blind and sighted subjects (Ss) in tactual sensitivity. It is generally believed by the man in the street that the hands of the blind, and their fingers, in particular, are more "sensitive" than those of the sighted. In psychophysiological terms, this would mean that the stimulus difference threshold of the skin receptors would be lower in the blind than in the sighted. One of the earliest investigators (Griesbach, 1899a, 1899b) found that the sensitivity of the cutaneous receptors is approximately the same in the blind as in the sighted.

Axelrod (1959) investigated differences between the congenitally blind and the sighted in light touch and two-point thresholds. As far as tactual thresholds were concerned, his results did not substantiate the old theory of compensation nor

the belief that blindness causes a general rise in limens. He found that early blind Ss had a lower two-point limen than sighted Ss on the right index finger. However, these blind Ss were Braille readers and mostly read Braille text using their right index finger.

It would seem that experience is an important variable in increasing the sensitivity of the blind. In this regard, Weiner (1963) found that when he separated two groups of children into good and poor Braille readers, the good readers performed significantly better on complex tests of tactual perception than did the poor readers. One has to assume that the differentiation between good and poor readers was based on experience with Braille rather than physiological differences.

Masuda (1963) divided 18 blind Ss ages 12 to 19 into two groups. The training group practiced the tactual reading of figures for two weeks. At the end of the training period, this training group's figure reading speed was 35.4% faster than the control group's. This effect was still observed 50 days later.

Worschel (1962) found no differences between the blind and sighted Ss in the tactual perception of form, although he did find that with increased practice, the sighted did significantly better than the blind.

In his discussion of the consequence of early sensory deprivation, Brunner (1961) suggests that when any one sense is nonfunctional, it also effects the perceptions based on the other sense departments. In this regard, Gomulicki (1961)

suggested that the congenitally blind do not attain the level of the sighted in many relatively simply tasks based on touch and hearing until the age of 15 or 16. He suggests that it is not until that age that the blind have learned to develop effective strategies for an adequate apprisal of the information mediated by the senses. In the sighted, vision is an assistance apprising information gained through the other senses. Presumably, if a sighted person were compelled to rely exclusively on tactual images--that is, if it were possible to deprive him of visual images altogether--it would take him a great deal of time to develop effective modes of sensory functions and it would also take time to learn to apprise the information thus received.

Juurmaa (1967) found that the totally blind compared unfavorably with the partially sighted and the sighted in tactual discrimination. These findings, however, may have been a function of the type of discrimination material used.

In a study investigating the interaction among sense modalities, Inoue (1968) found that while cutaneous memory was more developed in the blind than in the sighted, all Ss' performance was excellent in this modality and suggested the use of cutaneous material in all learning programs.

The results of studies of the tactual acuity of the blind and sighted can be summarized briefly by stating that, with the exception of the diabetic blind, thus far, no distinct differences have been observed.

Since there appeared to be a correlation between the ability to make finer and finer tactual discriminations and grade experience in blind children (Nolan, 1960), Nolan and Morris (1965) developed a 69-item test of tactual perception to be used primarily as a reading readiness test for Braille. A split-half reliability coefficient of .94 was achieved for the test and it was found to correctly predict whether a student, at the end of a year, would be in the upper or lower half of the group tested, i.e., predicting correctly 70% of the time in terms of oral reading errors and 75% of the time when speed of reading was the criterion. The findings of these studies indicated that the RDT was useful in evaluating readiness ability and predicting the degree of success in beginning Braille readers. Since the test is so constructed as to call for finer and finer tactual discriminations, it might have value in determining whether those who perform well on this test, also perform well in learning to discriminate between Braille characters.

Intelligence

Early investigation into the intellectual functioning of the blind was carried on in the various institutions for the blind around the turn of the century. Haines (1916), using a variation of the Binet scale, was the first to compare the performance of the blind and the sighted on the same test. He found that while the totally blind were only slightly inferior to the sighted in intelligence, partially blind Ss were definitely inferior. The partially blind, he pointed out, included

"feebleminded" individuals, who, because of their impaired vision, had been placed in a school for the blind rather than one for the mentally retarded. Haines also suggested that the causes of blindness often make for mental retardation as well.

Hayes (1950), who followed Haines in the area of intellectual comparisons among the blind and sighted, reports that blindness is not accompanied by mental retardation and that the age of onset of blindness does not bear on the intelligence. In general, he found that the standard deviation of I.Q's. was much higher for the blind than the sighted, in the various I.Q. test batteries he used. In other words, both superior and inferior performances were more frequent in relative terms among the blind than among the sighted. A partial explanation may lie in the fact that blindness is sometimes associated with other defects. On the other hand, blindness may be an obstacle which may be overcome only through concerted intellectual effort. It should also be noted that the education of the blind is often more individualized than that of the sighted.

Since the experimental data does not support the thesis that the blind are endowed with a special tactual ability, one might assume that differences in ability to learn Braille might be a function of intelligence. Points of view differ on this topic when Braille is seen as only one of a number of possible learning tasks.

Deese (1952) has stated that no one has been able to establish a very high relationship between intelligence, as measured by intelligence tests, and ability to learn in

laboratory tests of learning. He was, however, primarily concerned with relatively simple tasks. For example, Woodrow (1940) used such simple tasks as addition and code substitution and found no relationship between rate of gain and intelligence. Porter (1959) found that in the teaching of spelling, there was no significant relationship between intelligence scores and spelling scores.

However, Shay (1961) found that intelligence, as measured by standard intelligence tests, was positively related—at the .001 level of significance—to the ability to learn and effectively use Roman numerals.

The data are contradictory, and the results obtained may be more a function of degree of motivation than of intelligence. However, in view of these contradictory findings, it may be important to determine if intelligence, as measured by a standardized intelligence test, has any relationship to ability and ease at learning Braille.

Personality

Personality is an area of considerable interest to workers in the field of the blind. Their efforts have been primarily directed towards distinguishing differences in personality between sighted and blind, with the goal being to explain why the blind should be set apart from the sighted, in more ways than just their blindness. While it is recognized that blindness can play a role in one's approach to life, there

is no evidence to suggest that the blind are any more similar to each other or different from the sighted population because of their blindness.

While there is no "blind personality" as there is no "sighted personality," there appears little doubt that personality characteristics or traits, however they might be measured, may very well have some effect upon learning in general and the learning of Braille in particular. Although learning theory, in general, has as yet taken little account of the differences in personality characteristics among its Ss, Fry (1963) suggests that there are already indications that programmed instruction and the more conventional teaching methods will have to give more attention to this aspect of their students in the future. He feels that a dominating, confident person will attack learning, whether programmed or conventionally taught, quite differently from a submissive or unsure person. He also feels that different personality types, however they may be defined, may need to take different routes through the same body of S material and that the programmers must build this into their instructions.

Various instruments have been used as measures of "personality," The most popular and researched of the group of self-report questionnaires is the Minnesota Multiphasic Personality Inventory (MMPI) published by Starke Hathaway and J. C. McKinley (1951).

The MMPI purports to be able to differentiate between individuals on a variety of psychiatric scales. These psychi-

atric scales. These psychiatric characteristics might be considered shorthand terms for methods or strategies of behaving. One might expect a relationship among its various scales and motivation to perform well in a learning task, or ability to function in a frustrating situation. A frustrating situation might be defined as the learning of the Braille characters.

Statement of Problem

The expansion of the visual modality for information processing has particularly handicapped those individuals with the loss of this sense. The advent of the programmed machine and the use of programmed learning techniques as a method of teaching, offers a valuable potential for the blind who must rely on Braille as a means of information input. It becomes even more relevant when we realize the efforts currently underway to make Braille more accessible than previously. The need for Braille skills, coupled with the ever increasing availability of Braille material, suggests an increased use of machines--particularly programmed machines--to teach the skill. If machines are to be used most effectively, it would appear appropriate to investigate some of the variables that may play a part in determining the ease with which Braille can be acquired, as well as to determine the most effective and efficient method of programming a machine to teach this skill.

This paper will be concerned with the following variables and relationships in terms of their effect on the acquisition of Braille:

1. An investigation of three specific orders of presentation of the two primary stimuli involved in the learning process--the Braille character and its verbal identification--in order to determine, for programming purposes, the most efficient and effective temporal arrangement.

2. The teaching of Braille presupposes the utilization of the tactual modality. One might assume that differences in tactual sensitivity should be reflected in differences in ability to learn Braille. This study includes an investigation of this relationship as well as to evaluate an instrument primarily designed to detect tactual differences.

3. Intellectual ability has consistently been related to learning and will be so investigated in this study. The intellectual estimate will be obtained through the use of the Army General Classification Test (AGCT).

4. The final general area of concern is that of Personality and its relationship to the learning of Braille. The problem in this area is one of agreement upon a definition of personality and then to quantify this definitiom in usable terms. The Minnesota Multiphasic Personality Inventory (MMPI) offers a beginning in this effort and will be utilized.

CHAPTER II

METHOD

Introduction

The type of learning with which we are concerned is that involving the acquisition of a motor skill, specifically reading Braille. This particular skill involves the ability to sense differences between tactual stimuli, the cognitive activity of attaching a name to these differences, as well as the actual verbal behavior of responding with the correct identification. The procedure involves basically two phases: a familiarization and primary learning phase and a testing and secondary learning phase. Both phases are considered within the realm of the paired-associate paradigm (Hall, 1966).

Apparatus

The experiment was conducted in a closed room. The Subject (S) and the Experimenter (E) were alone in the room with the S seated directly opposite E. E familiarized S with the experimental apparatus and material (see Appendix A, pp. 61-62), fitted him with a blindfold, helped arrange his chair so that S's finger was in the proper position on the teletouch machine and insured that his forearm was lightly resting on the table. E put on earphones connecting him to channel 2 of the tape recorder.

To present the Braille character, a "Teletouch" was used. This is a special communicator developed and manufactured by the American Foundation for the Blind for special use in communicating with deaf-blind persons. It consists of a regular typewriter keyboard that, upon pressing, results in an instantaneous projection of a Braille cell on a small oval space behind the keyboard.

A Sony, 4-track, 2-channel tape recorder was used for presentation of the material to the S and to the E. One channel of the recorder presented auditory feedback to the S from the built-in speaker in the machine in the order determined by the four groupings. The second channel led to the E through an earphone, and, at the same time, gave him the correct timed instructions for locating the correct letter key, pressing it down and releasing it. A schematic representation of the action of the two channels and the time sequence used is included in Appendix A, p. 63.

A record sheet (Appendix A, p. 64) was used to record the S's responses during Phase II in order to determine when he had completed his three errorless trials as well as to serve as his score for the experiment.

Each S was required to wear a blindfold which consisted of a pair of wrap-around sunglasses with the lenses painted black.

Self-scoring sheets for the RDT (Appendix A, p. 65) were used. The RDT is composed of 69 cards each of which contain three similar and one different squares of sandpaper ranging in grit

size from 24 to 600. The task is to identify the one which is different. The RDT was given to each S prior to beginning Phase I of the experiment.

Braille Selection

Braille is a raised dot, punctiform system of reading and writing employed by the blind. These dots are grouped in rectangular cells, three-dots high and two-dots wide. Each Braille character is made by using one dot or two or more dots in various combinations within the cell. Sixty-three combinations of dots or characters are possible.

The selection of the Braille characters to be used was based on the following considerations:

1. To control for the number of dots, three each of one-dot, two-dot, and three-dot characters were used. Since Braille has only one one-dot character, two of the characters selected do not conform to actual Braille.
2. Control for the particular patterning of the characters was based on the limited number of patterns available as well as an inspection. The letters selected, with the exception of two of the one-dot characters, were ranked on the easy end of a continium of difficulty by Heber, et al. (1957).

Table 1 is a list of the Braille characters used with their paired associate letters of identification.

Demographic Data

Various identifying information, including age, educational achievement and an intelligence estimate (AGCT scores) was obtained on each S. This information is routinely collected on all inmates and is obtainable from the research files in the

research section of the Psychology Department. T scores for the major psychiatric and the three validity scales of the MMPI were also obtained. These scale names, symbols by which they are known, and numbers by which they are coded are given in Table 2.

TABLE 1

Braille Characters with their Paired Associate Letters

Braille	Associate Letter	Braille	Associate Letter	Braille	Associate Letter
● ○ ○ ○ ○ ○	A	● ○ ● ○ ○ ○	B	● ○ ○ ● ● ○	O
○ ○ ○ ○ ○ ●	S*	● ● ○ ○ ○ ○	C	● ○ ● ○ ● ○	L
○ ● ○ ○ ○ ○	K*	○ ● ● ○ ○ ○	I	● ○ ○ ○ ● ●	U

*Do not conform to actual Braille.

TABLE 2

MMPI Scales: Names, Symbols, and Numbers

Name	Symbol	Number
Validity Scales:		
Lie	L	1
Frequency	F	2
Correction	K	3
Clinical Scales:		
Hypochrondriasis	Hs	1
Depression	D	2
Hysteria	Hy	3
Psychopathic deviate	Pd	4
Masculinity-feminity	Mf	5
Paranoia	Pa	6
Psychasthenia	Pt	7
Schizophrenia	Sc	8
Hypomania	Ma	9
Social Introversion-extroversion	Si	0

An arbitrary limit for normality of two standard deviations above and below the mean has been established (T scores between 30 and 70) (Marks and Seeman, 1963).

Interpretatively, and in simple terms, single scale elevations above the normal limits are considered to have the following characteristics: L, rigidity or naiveté; F, confused thinking or self-depreciation; K, defensiveness; Hs, hypochondriasis and body narcissism; D, depression; Hy, repression and denial; Pd, immaturity and impulsiveness; Mf, passivity (for males), interests characteristic of opposite sex; Pa,

sensitivity, hostility; Pt, anxiety, obsessive thinking; Sc, confused, schizoid, bizarre thinking; Ma, euphoria, hyperactivity; Si, withdrawal, introversion. Low scales can also be interpreted (Gilberstadt and Duker, 1965).

Subjects

The population of available Ss consisted of all inmate volunteers at the Minnesota State Prison, residing there from January until June of 1969. A total of 60 Ss participated in the experiment.

Groups

The Ss were randomly assigned to one of four groups. The instructions for each group differed in Phase I of the experiment. (See Appendix A, p. 66, for a schematic representation of the four groups.)

Group I received both the raised Braille character and the taped explanation of the character simultaneously and for one-second duration with a five-second delay between pairings. The taped instructions for the Ss in Group I are given in Appendix A, p. 67.

Group II received the raised Braille character for one-second duration. After an interval of three seconds, the tape recorder reported the identification of the character. A two-second interval followed each pairing. Appendix A, p. 67, includes the taped instructions given this group.

Group III received the taped explanation (Stimulus 2) for one-second duration, followed three seconds later with the

tactually experienced Braille character (Stimulus 1). A two-second interval followed each pairing. (See Appendix A, p. 68, for the taped instructions for Group III.)

Group IV was a control group and allowed for relatively similar familiarity between all groups on tactual experience. In this group, the raised Braille character was presented for one-second duration with a five-second inter-stimulus interval. Stimulus 2, the taped explanation, was not given. (See Appendix A, p. 69, for the taped instructions given this group.)

Procedure

Phase I

Each group was handled in the same manner except for the one variable noted above. Nine different tactually experienced Braille characters with their taped explanation (with the exception of Group IV) constituted a series, and the series was repeated ten times. The nine Braille characters and their taped identification were presented in a random order within each trial or series with the same two-second inter-series delay. No response was required of the S in this phase of the experiment.

Phase II

The experimental conditions were identical for all groups in this phase of the experiment and represent the testing trials as well as further learning trials for all groups. The taped instructions (Appendix A, p. 70) were the same for all

groups. In this phase, the raised Braille character was presented to the S for one-second duration. From its onset and for a total of four seconds, the S was required to make a verbal response of identification of the character. At the close of this four-second delay, the tape recorder supplied the correct answer. Group IV, which did not experience the auditory identification of the tactually experienced Braille character during Phase I, was asked to respond with an identification beginning with the second trial. This procedure continued for all groups with the nine Braille characters and their verbal identification being presented randomly until the S was able to anticipate or correctly respond to the Braille character before the tape recorder supplied the correct answer. This procedure continued until the S had completed three consecutive errorless trials.

Phase III

This was a retention phase and required that each S return the day following his initial experimental participation to repeat Phase II of the experiment. The procedure was identical to that which he experienced the preceding day.

CHAPTER III

RESULTS

Order of Presentation

The total number of trials to criterion, including the three errorless trials, constituted a S's score. Scores for all Ss in the four groups are given in Appendix B. The Mean Learning trials to criterion for all groups are shown in Table 3.

TABLE 3

Mean Learning Trials to Criterion for
Groups I, II, and III, and
Control Group IV

Score	Group			
	I	II	III	IV
Mean	18.86	13.47	16.33	31.93
Standard Deviation .	9.01	11.38	10.86	11.39

A simple analysis of variance was conducted with the results given in Table 4. A multiple comparison test (t test) for all groups is given in Table 5.

TABLE 4

Analysis of Variance of Four Groups (N = 60) on Number of Trials to Criterion

Source	Sums of Squares	*df*	Mean Squares	*F*
Within groups	6989.72	56	124.82	
Between groups	4662.60	3	1554.20	12.48*
Total	11652.32			

*Significant beyond the .01 level of confidence, 3.56 *df*.

TABLE 5

Mean Differences for All Groups

Groups	I	II	III
II	5.39		
III	2.53	2.86	
IV	13.07*	18.46*	15.60*

*Critical difference (*t* test) = 8.75, at .05 level of confidence, 28 *df*.

Analysis of the data adequately supports the hypothesis that prior experience influences learning, but fails to support the hypothesis that order of presentation is a significant variable in the learning of Braille.

Retention

Appendix B presents the total number of trials to reach the relearning criterion, including the three errorless trials, for each S in the retention phase of the experiment. The mean number of relearning trials to criterion for all groups is given in Table 6.

TABLE 6

Mean Number of Relearning Trials to Criterion for Groups I, II, and III, and Control Group IV

Score	Group			
	I	II	III	IV
Mean	6.27	7.00	5.93	7.27
Standard Deviation .	3.17	8.63	6.32	4.76

A simple analysis of variance was conducted, with the results given in Table 7.

Analysis of the data supports the null hypothesis that no differences exist between the groups on ability to retain the previously learned Braille material some 24 hours later.

TABLE 7

Analysis of Variance of Four Groups (N = 60) on Number of Trials to Criterion

Source	Sums of Squares	df	Mean Squares	F
Within groups	2216.79	56	39.59	
Between groups	7.39	3	2.45	.06
Total	2224.18	59		

Tactual Sensitivity

Appendix B, p. 74, presents the subjects' scores, by group, on the RDT. A high score reflects a greater ability to detect differences. The highest possible score is 69.

Table 8 presents the mean score on the RDT for all groups.

TABLE 8

Mean Scores on the RDT for Groups I, II, and III, and Control Group IV

Score	Group			
	I	II	III	IV
Mean	60.87	60.80	61.67	60.00
Standard Deviation	3.67	6.50	4.12	5.83

No differences are evident between groups on the RDT.

In order to determine if performance on the RDT has any relationship to the ability to learn or retain Braille, as well as its possible relationship with other variables of interest, Table 9 is presented. As can be seen from Table 8, the RDT does not significantly differentiate between fast and slow learners in the original Braille learning task, although there appears to be a trend in that direction. However, there is a significant positive correlation between the score on the RDT and the score achieved on the relearning phase of the experiment and also significant correlations with Scales 4, 5, 8, and 9 of the MMPI. This suggests that those who score high on the psychopathic deviate scale (4) and whose interests more closely parallel those of the opposite sex (Scale 5) perform better on the RDT. In addition, those who admit to less confused and bizarre thinking (Scale 8) and who are less euphoric (Scale 9) achieve a higher RDT score.

Intelligence

AGCT scores for all groups are given in Appendix B, p. 75, with the mean and standard deviation for all groups listed in Table 10.

Table 11 gives the correlations of intelligence, as measured by the AGCT, with the experimental variables as well as other demographic variables.

Analysis of the data reflects a significant correlation between intelligence, as measured by the AGCT and Number of Trials to Criterion of three errorless trials. While the correlation between AGCT and number of trials to relearn the

TABLE 9

Correlations of Tactual Sensitivity Scores (RDT) with Selected Variables (N = 60)

Variables	r
Trials to Criterion	-.15
Relearning Trials	-.26*
Intelligence (AGCT)	.08
Educational Level	.08
MMPI Scales	
Lie Scale	-.12
Frequency Scale	.10
Correction Scale	.01
Hypochondriasis Scale	.08
Depression Scale	.20
Hysteria Scale	.10
Psychopathic Deviate Scale	.53*
Masculinity-Femininity Scale	.36*
Paranoia Scale	.13
Psychasthenia Scale	.18
Schizophrenia Scale	-.39*
Hypomania Scale	-.27*
Social Introversion-Extroversion Scale	.09

*Significant at the .05 level of confidence.

TABLE 10

Mean Scores on the AGCT for Groups I, II, III, and IV

Score	Group			
	I	II	III	IV*
Mean	109.60	119.87	116.40	115.00
Standard Deviation	19.03	16.18	16.98	21.98

*Control group.

TABLE 11

Correlations of AGCT with Selected Variables
(N = 60)

Variables	r
Trials to Criterion	−.28*
Relearning Trials	−.21
Tactual Sensitivity (RDT)	.08
Education Level	.47*

*Significant at .05 level of confidence.

Braille material is not significant, the trend is suggestive. As would be expected, there is a significant correlation between educational level achieved and intelligence.

Personality Factors

Table 12 presents the correlations of the MMPI with the experimental variables. The significant correlations which exist between Scales 4, 5, 8 and 9 of the MMPI and the scores achieved on the RDT have been previously reported in the tactual sensitivity section of this chapter. In addition to these significant correlations, we find that Scale 9 of the MMPI correlates with Trials to Criterion in the original learning, suggesting that those who admit to symptoms of euphoria and/or hyperactivity on the MMPI, tend to take longer to reach criterion of three errorless trials. The opposite can be said of Scale 5, where the lower the masculinity score (i.e., the more "masculine" the S reports himself to be) the better his performance on the original learning situation.

TABLE 12

Correlations of MMPI Scales with
Experimental Variables (N = 60)

MMPI Scales	Trials to Criterion	Relearning Trials	Tactual Sensitivity (RDT)
L	.18	.16	-.12
F	.03	.06	.10
K	.19	.16	.01
1	-.03	.09	.08
2	.04	.09	.20
3	-.03	.21	.10
4	.11	.12	.53*
5	-.34*	-.12	.36*
6	-.03	.07	.13
7	.11	.08	.18
8	.16	.01	-.39*
9	.29	.01	-.27*
0	.10	.06	.09

*Significant at the .05 level of confidence.

CHAPTER IV

DISCUSSION

This experiment was concerned with the effects of a number of pre-training situations on the learning of Braille. Three orders of presentation of the tactually experienced Braille characters and their verbal identification were investigated with an additional group added to control for the effect of tactual familiarity. Phase I for each group allowed for differing orders of presentation and, as such, can also be seen as coming under the sensory preconditioning learning paradigm, specifically the Relevant Stimulus-No Response kind of pre-training suggested by Hall (1966). Hall concludes, on the basis of a large number of experimental studies, that Relevant Stimulus-Relevant Response pre-training is the most effective form of pre-training. In each of the three experimental groups, there is a relevant stimulus and a relevant response in Phase I which then becomes part of the stimulus and response requirement of Phase II. In each of the three groups we find learning occurring significantly faster than the control group (IV). Group IV can then be considered under the Relevant Stimulus-No Response paradigm and again in terms of the research reported by Hall (1966), be expected to perform at a lower level than the Relevant Stimulus-Relevant Response sensory pre-conditioning paradigm.

Considering the results of this study, it appears that the sequential ordering of the two stimuli is not a significant factor in the learning of Braille, at least as it was defined in this study. Basically, this finding would suggest that those involved in setting up programmed material for the teaching of Braille need not be overly concerned with the ordering or manner by which they present the tactual and verbal stimuli.

While a significant statistical difference does not exist, further examination of the data would suggest a trend favoring Group II. Were this trend significant, a partial explanation for the somewhat better performance of Group II may lie in the fact that the experimental procedure for this group remained the same in both phases and the Ss did not have to shift their learning sets during the total experiment, as was necessary with the other experimental groups. Another possible explanation has to do with the instructions given the Ss prior to beginning the experiment. Since each S was told that he would be required to give a verbal response of identification to each of the tactually experienced Braille characters during the second phase of this experiment, one might assume that attempts were made during Phase I to learn the paired associates even though it was not required. If this type of cognitive activity were going on, and it can only be hypothesized, it would then seem likely that some degree of reinforcement was being given the Ss, probably in the form of knowledge of results of their nonverbal efforts. This is assuming, of course, that knowledge of results is an important learning variable.

Greenspoon and Foreman (1956) found it to be so. Hall (1966) in his discussion of this topic concludes that at least as far as human experimentation is concerned, knowledge of results may profitably be viewed as a construct under the reinforcement rubric.

If, then, the Ss are utilizing the auditory feedback during Phase I constructively, one would expect better performance than in those Ss who did not have the opportunity to experience Stimulus 1, attempt to identify it, and be rewarded with the auditory explanation. This possibility has more credence when one considers that over half the Ss in Group II were able to achieve criterion in 10 trials or less, whereas none in Group IV and only a small number in Groups I and III were able to do so.

While we were not able to demonstrate a significant difference in favor of Group II, neither is any other ordering of the two stimuli to be preferred.

Consequently, in view of other suggestive information, it would seem most profitable to design Braille programmed learning situations so that the auditory feedback follows the tactually experienced material after a short interval. This suggestion would be consistent with the findings of Wolfle (1932), Bernstein (1934), Reynolds (1945) and others who found that most efficient order of presentation of the stimuli in a conditioning situation favored short forward conditioning, i.e., where Stimulus 1 precedes Stimulus 2 by a short interval.

Retention

The four groups were found to be equal in the degree to which they were able to retain the Braille material over a 24-hour period. Of importance here is the apparent fact that no matter the method by which a skill is acquired, particularly as it relates to Braille acquisition, retention is constant over the time period considered and one cannot differentiate between various methods of presentation and retention of the material. This would be consistent with Underwood's (1954) study of Ss who learned a serial list of 12 nonsense syllables to a particular criterion and were consistent 24 hours later to the degree to which they had originally learned the material.

Examination of the individual scores achieved by the Ss reflects the relatively high retention rate or the low rate of forgetting for all groups. This might be partially accounted for by the uniqueness of the task itself. By using the tactual modality we are not involved with prior learning in general and particular learning sets which may have been built up over time. In this regard, those Es who need to control for prior learning and specific experiences, might find the tactual modality, and specifically Braille, a valuable adjunct in their learning experiments.

Tactual Sensitivity

The RDT does not discriminate between Ss in their ability to learn Braille. A -.15 correlation between the RDT and number of Trials to Criterion in the original learning situation

is not significant at the .05 level of confidence, although the trend is in that direction. It must be remembered, however, that this test was designed to be used by blind people, particularly young people, for making predictive statements about their ability to learn Braille over a one-year period. This test was standardized on 140 children considered Braille readers or potential Braille readers enrolled in the Ohio and Kentucky residential schools for the blind during the period October, 1960 to February, 1961. These children ranged in age from 6 to 14. The test manual itself states "the test was not designed for use with older children or adults" (Nolan and Morris, 1965). Consequently, we are not criticising the test because it does not predict beyond its design. Its use in this study and with the prison population was two-fold: First, to see if another population could be used for predictive purposes and to see if the test had any value in discriminating between finger sensitivity and its relation to learning Braille. Secondly, the test itself would have profited from further validation.

Examination of the particular scores achieved by each S suggests that the test did not allow for sufficient variability within Ss. An overall mean of 61 on a 69-item test suggests that perhaps the discriminative tasks were not fine enough to allow for individual differences. The gross differences reflected in the test appear specifically designed for its validating population.

While there was no significant correlation between the RDT and Trials to Criterion on the original learning task, it

is interesting to note the significant negative correlation existing on the number of relearning trials and the RDT. This would suggest that those who scored high on the RDT also tended to reach criteria of three errorless trials the second time more rapidly than those who scored low on the RDT. This finding might suggest that other factors than strictly tactual sensitivity were operating in the original learning situation but that when the task called for the relearning of previously experienced material, Ss with finer tactual discriminative ability, were able to detect the necessary differences and attach them to the correct responses.

Two hypotheses exist regarding the potential usefulness of the RDT in a prison population, or any other population: One is that it has potential in its ability to differentiate between degrees of tactual sensitivity, no matter the population and that all that is required is the test include finer and finer discriminations (i.e., smaller grit size sandpaper) as the age of the population increases.

The second hypothesis is that the test does not differentiate between degrees of tactual sensitivity defined along a continuum of gross to fine. Since this test was standardized on a blind population and neurological defects are also associated more frequently with blindness, it may only discriminate between neurological damaged and nonneurological damaged individuals and is not relevant for any other use. This would explain, in part, its inability to significantly discriminate within a prison population since few inmates have neurological

damage. This is an empirical question which may warrant further investigation.

The significant correlations existing between the RDT and Scales 4 and 9 of the MMPI will be discussed in the section dealing with personality.

Intelligence

The AGCT is a general test of intellectual ability developed and standardized on military recruits. It is a group test and, as such, has potential value in an institutional setting when a gross measure of mental ability is needed. In terms of this experiment, a significant negative correlation exists between intelligence and number of trials required to learn Braille. In terms of the correlation, it suggests that the higher the AGCT score, the fewer the number of trials needed to reach criterion. This is consistent with expectations regarding the relationship between learning and intelligence. A negative correlation also exists between intelligence and number of trials in the relearning phase of the experiment, but this correlation is not significant. Also, as expected, a positive and significant correlation existing between educational level and intelligence was indicated.

Personality Factors

Personality as a construct to be experimentally investigated has always presented problems both in definition and measurement. In order to avoid becoming involved in the myriad of problems associated with an agreed-upon definition or the

question of the validity of the measuring instrument used, we have arbitrarily decided to utilize an instrument possessing a considerable body of supportive research and generally recognized as valuable in the clinical diagnosis of certain psychiatric disorders. The MMPI will give an objective "score" on each of its 10 major psychiatric scales and three validity scales. This "score" is in the form of standard score equivalents for the raw score on each of the scales (Dahlstrom and Welsh, 1960). It was felt that the manner with which each subject approached the test may possibly be related to the manner with which he approached the experimental situation, and if the test measures what it purports to measure, we might find some T score differences between Ss in their ability to learn Braille.

Most scale correlations are not significant, and with one exception, all others barely reach the .05 level of significance.

A significant negative correlation between the number of Trials to Criterion in the original learning situation and Scale 5 (Masculinity-femininity) may reflect Scale 5's general positive correlation with education and intelligence. Scale 5 also is considered a measure of sophistication and aesthetic interest. Individuals who score high on this scale may have possessed greater interest, motivation, and perhaps have seen the challenge in the experimental situation. The significant positive correlation observed in this scale and the RDT score can possibly be interpreted in a similar manner, rather than suggesting differences in the tactual modality.

Scale 8 is designated as the Schizophrenia scale. Characteristic of individuals who score high on this scale is a sense of social alienation, isolation, bizarre feelings, and general dissatisfaction. Even with moderate elevations, there is usually some admission of difficulty in thinking and communication. In these descriptive terms, then, one might think that high Scale 8 scorers would find it difficult to concentrate sufficiently to complete the task or have difficulty understanding and attending to the directions in the experiment, and that this inability should be reflected in their scores on the various experimental variables. However, it seems to have had no effect on their ability to learn the Braille characters or to relearn them the following day. However, there does appear to be a significant negative correlation between this scale and performance on the RDT. Why this difference appears and is not found with the Braille material is difficult to determine and may only be a function of chance. Certainly, one might assume that a person who admits to the peculiarities and confusion represented in Scale 8 and who, in fact, does experience these factors in his everyday existence, would have difficulty not only distinguishing between grit size on the RDT, but also between the various dot configurations of the Braille characters.

Scale 9 was derived from the affective disorder, hypomania, and is primarily characterized by over-activity, emotional excitement and flight of ideas. High scorers are seen as warm, enthusiastic, expansive, generally outgoing and unin-

hibited individuals. High 9 people also are seen to have an unusual capacity for sustained activity and effort although in more extreme cases, the activity is inefficient and unproductive.

With Scale 9 characteristics, it would seem likely that high 9 scorers may do better on the experimental tasks than low scorers. This does appear to be the case. A significant positive correlation between Scale 9 and the number of trials to reach criterion on the original learning is evident as well as a significant negative correlation existing between Scale 9 and the RDT.

The final scale correlation to be discussed here is that of the psychopathic deviate (Pd) scale, or Scale 4. This scale was initially developed to measure the personality characteristics of Ss whose personality pattern included a general social maladjustment, an inability to plan ahead, impulsiveness and an inability to profit from past experience. It is also the most frequent high point scale in the general prison population, as well as in our sample (see Fig. 1 and 2). The significant positive correlation between this scale and the score achieved on the RDT suggests that Ss who admit to possessing a greater degree of the characteristics listed above, are able to do better on the RDT. Whether high 4 Ss then can be said to have a finer sense of touch than low 4 people does not necessarily follow since it appears to have no significant value in aiding them in the acquisition of Braille skills. Until further investigation is conducted regarding the variables contributing

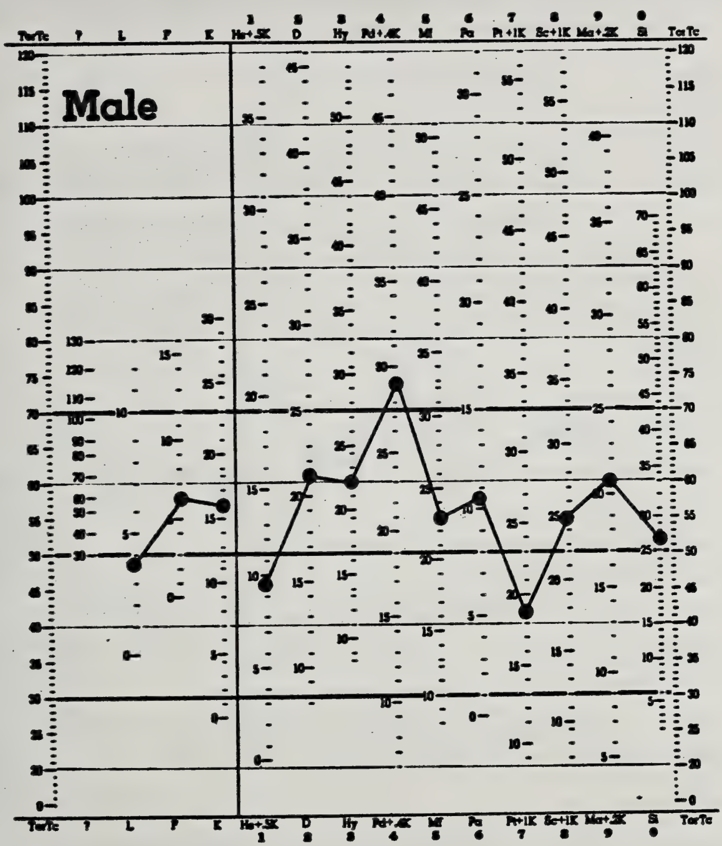

Fig. 1. Mean MMPI Profile of Experimental Prison Population (Sample N = 200). (MMPI published by Starke Hathaway and J. C. McKinley, in Minnesota Multiphasic Personality Inventory manual. New York: N. Y. Psychol. Corp., 1951.)

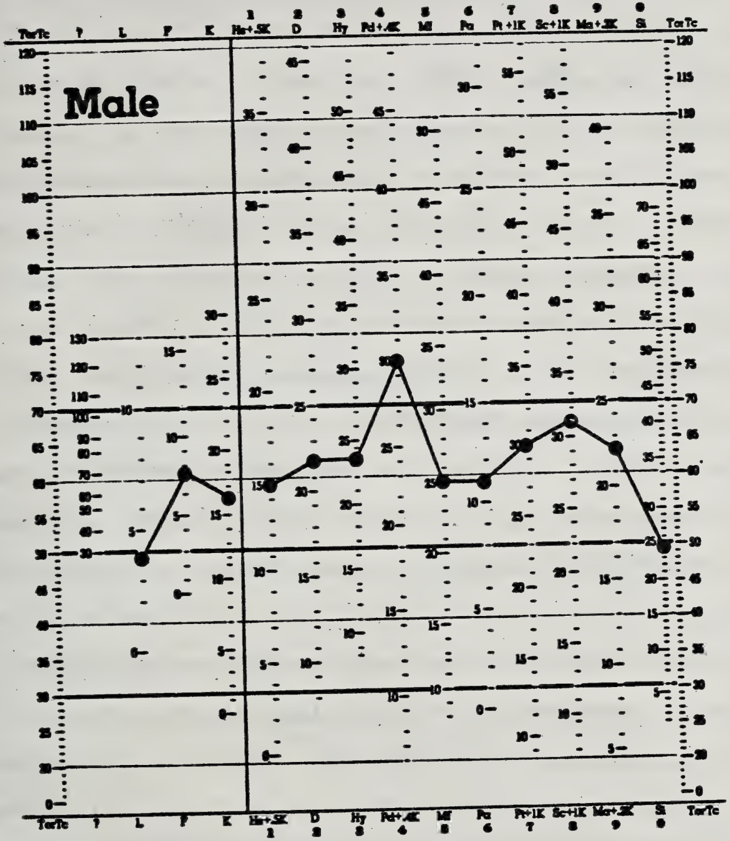

Fig. 2. Mean MMPI Profile of Experimental Prison Population (Sample N = 60). (MMPI published by Starke Hathaway and J. C. McKinley, in Minnesota Multiphasic Personality Inventory manual. New York: N. Y. Psychol. Corp., 1951.)

to this high correlation, it appears most appropriate to let it stand as a peculiarity of the experiment and a topic of further investigation.

There seems to be no correlation between Scale 4 and the actual acquisition of Braille. This finding is contrary to expectations. If the acquisition of a new skill offers potential for the existence of a frustrating situation, and if one of the characteristics of high 4 people is an inability to tolerate frustration, then it might be expected that a negative correlation would exist, or at least a trend in this direction.

This section has concerned itself with the question of whether personality variables, as defined and measured by the MMPI, have an effect on the ease with which a skill is acquired and, secondly, whether an instrument of this type can be used as an objective and useful measure of predicting behavior in an experimental situation.

We have primarily been dealing with single scale T scores in terms of their individual correspondence to any of our experimental variables. Personality evaluation or diagnosis generally takes the form of interpretation based on configural patterns rather than single scale elevations.

If the MMPI has value in its ability to differentiate between various personality characteristics and if these characteristics, as defined and measured, have a bearing upon the way a new experience—in this case, Braille—is handled, it should be more discernible if we obtain the mean of the fast Braille learners (low scorers) with the slow learners (high scorers).

Figure 3 presents the mean MMPI T score comparisons between 15 fast learners and 15 slow learners. It is presented in profile form and reflects very little difference between these two groups.

It is expected that personality variables do play a part in the manner and method with which a learning task is approached and handled. We were able to detect some significant relationships between our learning variables and the objective and quantified scales of the MMPI. That these relationships do, in fact, represent the effect of specific personality characteristics on the learning process is only suggestive. A particular personality "type" may very well, handle both experiences—the Braille learning and the MMPI test—in a similar fashion, and what we might be primarily dealing with is test taking attitude or behavior, rather than particular personality "types."

Continued investigation appears particularly relevant in this area and might most profitably be begun with those personality characteristics as measured by the MMPI that seem to be related, in some way, with our learning variables.

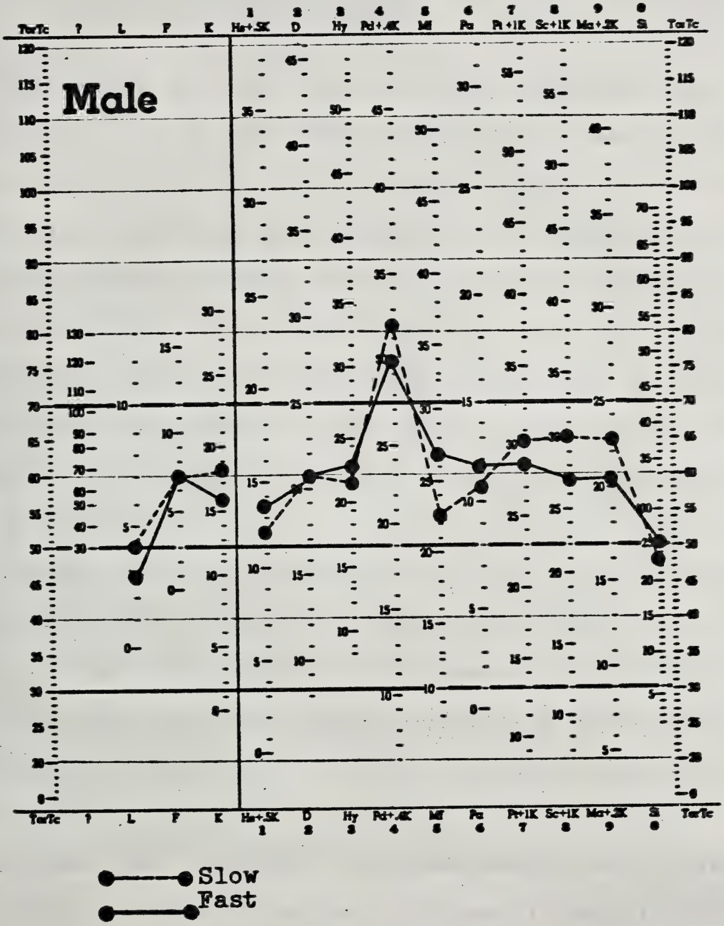

Fig. 3. Mean MMPI Profile of 15 Fast Learners and 15 Slow Learners. (MMPI published by Starke Hathaway and J. C. McKinley, in Minnesota Multiphasic Personality Inventory manual. New York: N. Y. Psychol. Corp., 1951.)

CHAPTER V

SUMMARY

This paper has been concerned with investigating some of the variables which have been considered to have an effect in the acquisition of skills in general and Braille in particular. With the continued advancement in the design and construction of programmed machines, as well as the increasing availability of Braille, it was considered important at this time to investigate not only the variables which might be operating in determining the most efficient learning but also to investigate some of the variables involved in the actual programming of the machine itself.

Three orders of presentation of the tactually experienced Braille character and its auditory explanation were presented. The first temporal arrangement considered was similar to that found in classifical conditioning experiments in which Stimulus 1 precedes Stimulus 2 by a short interval; the second condition required that both stimuli be presented simultaneously; and the third order of presentation was a reversal of the first, in which Stimulus 1 followed Stimulus 2 after a short interval. One additional condition was utilized in which Stimulus 1 was presented with the absence of Stimulus 2. This was a control condition to insure equal tactual familiarity.

Analysis of the results suggests a trend, although not significant, favoring short forward conditioning, in which Stimulus 1 precedes Stimulus 2 by a short interval.

There were no differences between the groups in their ability to retain the Braille material over a 24-hour period, suggesting that once a skill is acquired to a certain criterion, no matter the number of trials or length of time involved in reaching that criterion, ability to retain the skill is constant over Ss.

The RDT was not able, in this experiment, to predict ability to learn Braille. Other than that the test did not allow for sufficient variability within Ss, and additional explanation for its failure to predict might be that the test did not include fine enough discriminations for an older population or that the test is not able to differentiate between Ss with neurological damage and those without, rather than an ability to detect the degree of tactual sensitivity.

Intelligence, as expected, and as defined by the AGCT, appeared to have a positive relationship to learning. This also held true with the educational level.

An attempt was made in this study to relate various personality characteristics as defined by the MMPI, with other demographic variables as well as the learning variables. It is generally accepted that personality characteristics or an individual's strategy for dealing with situations, would have a bearing on learning in general and in skill learning in particular. Ten objective and quantified psychiatric scales of the

MMPI and the three validity scales were compared with other demographic data and the experimental variables to determine if there were any relationships existing. Some relationships were significant although a more exact explanation must wait for further experimentation.

There is little doubt but that the need for Braille skills will continue to increase and as more and more of the non-Braille reading blind population seek instruction in this skill, automatic, programmed machines will be needed to keep up with the demand. Continued research in this direction is imperative if we are to meet the needs that currently exist and which are projected for the future.

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APPENDIX A

INSTRUCTIONS AND MATERIALS USED IN STUDY

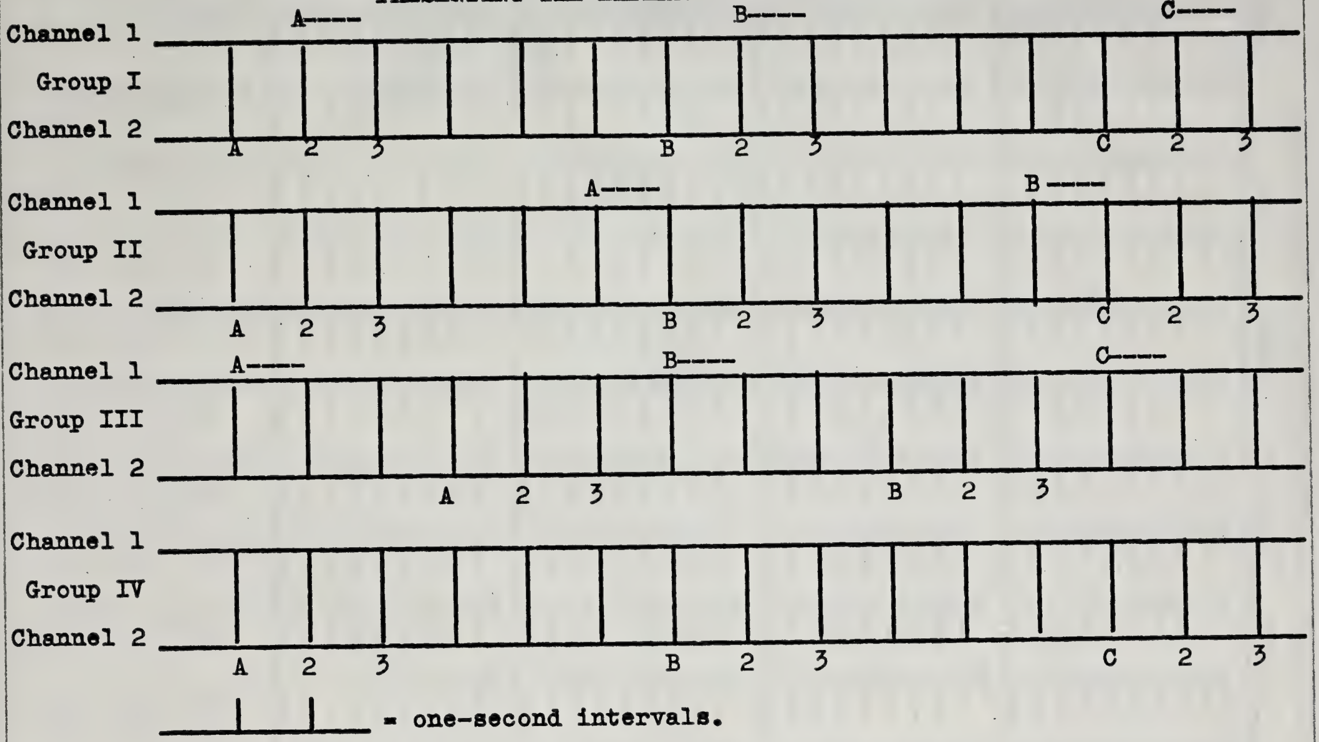
INSTRUCTIONS TO SUBJECT

To rule out the effect of vision, you will be asked to accept a blindfold during the experiment. Your task will be to learn nine Braille characters by touch. These nine characters stand for nine letters in the alphabet. The procedure for presentation is standardized and automated as much as possible. You may find it very difficult to discriminate differences at first because of unfamiliarity and the speed of presentation. However, please bear with us and do as well as you can. There will be two phases in this experiment: one a familiarity and training phase and the other a learning and testing phase. Instructions will be given you on tape prior to each phase.

INSTRUCTIONS TO EXPERIMENTER

Let the subject examine the machine, explain how it works. Place his finger (right forefinger if right-handed) in the small oval space, so that it completely covers the space. Blindfold the subject after having placed him in a comfortable position, with some type of arm rest for his right forearm and insure that his forefinger is lightly touching the oval space. Put on the earphones, placing yourself in front of the teletouch machine and operate the keyes, as per taped instructions, with your left hand (if right-handed). This will leave your right hand free to record responses during Phase II of the experiment. Turn on the tape recorder for the proper taped instructions.

SCHEMATIC REPRESENTATION OF THE METHODS EMPLOYED IN PRESENTING THE EXPERIMENTAL MATERIAL



= one-second intervals.

Equipment: Sony 2-channel tape recorder.
Channel 1: Direct verbal feedback to subject; i.e., A, B, C, etc.
Channel 2: Experimenters instructions via earphones: 'A' find letter on keyboard; '2' push down letter; '3' release letter, etc.

RECORD SHEET SUBJECT'S RESPONSES, PHASE II

Name_________No._______Date_______Group_______Trial_______

****

A___	B___	C___	I___	K___	O___	S___	L___	U___	K___	A___
U___	O___	B___	K___	O___	S___	L___	S___	K___	U___	O___
B___	S___	A___	C___	U___	K___	I___	O___	L___	S___	L___
C___	U___	O___	A___	B___	A___	K___	A___	B___	A___	B___
S___	K___	U___	B___	L___	B___	U___	K___	C___	B___	U___
L___	C___	L___	U___	A___	U___	B___	C___	A___	L___	K___
K___	A___	I___	S___	C___	I___	A___	B___	O___	C___	S___
I___	L___	K___	O___	I___	C___	O___	U___	I___	O___	C___
O___	I___	S___	L___	S___	L___	C___	I___	S___	I___	I___

****

A___	B___	C___	I___	K___	O___	S___	L___	U___	K___	A___
U___	O___	B___	K___	O___	S___	L___	S___	K___	U___	O___
B___	S___	A___	C___	U___	K___	I___	O___	L___	S___	L___
C___	U___	O___	A___	B___	A___	K___	A___	B___	A___	B___
S___	K___	U___	B___	L___	B___	U___	K___	C___	B___	U___
L___	C___	L___	U___	A___	U___	B___	C___	A___	L___	K___
K___	A___	I___	S___	C___	I___	A___	B___	O___	C___	S___
I___	L___	K___	O___	I___	C___	O___	U___	I___	O___	C___
O___	I___	S___	L___	S___	L___	C___	I___	S___	I___	I___

****

A___	B___	C___	I___	K___	O___	S___	L___	U___	K___	A___
U___	O___	B___	K___	O___	S___	L___	S___	K___	U___	O___
B___	S___	A___	C___	U___	K___	I___	O___	L___	S___	L___
C___	U___	O___	A___	B___	A___	K___	A___	B___	A___	B___
S___	K___	U___	B___	L___	B___	U___	K___	C___	B___	U___
L___	C___	L___	U___	A___	U___	B___	C___	A___	L___	K___
K___	A___	I___	S___	C___	I___	A___	B___	O___	C___	S___
I___	L___	K___	O___	I___	C___	O___	U___	I___	O___	C___
O___	I___	S___	L___	S___	L___	C___	I___	S___	I___	I___

****

A___	B___	C___	I___	K___	O___	S___	L___	U___	K___	A___
U___	O___	B___	K___	O___	S___	L___	S___	K___	U___	O___
B___	S___	A___	C___	U___	K___	I___	O___	L___	S___	L___
C___	U___	O___	A___	B___	A___	K___	A___	B___	A___	B___
S___	K___	U___	B___	L___	B___	U___	K___	C___	B___	U___
L___	C___	L___	U___	A___	U___	B___	C___	A___	L___	K___
K___	A___	I___	S___	C___	I___	A___	B___	O___	C___	S___
I___	L___	K___	O___	I___	C___	O___	U___	I___	O___	C___
O___	I___	S___	L___	S___	L___	C___	I___	S___	I___	I___

****

A___	B___	C___	I___	K___	O___	S___	L___	U___	K___	A___
U___	O___	B___	K___	O___	S___	L___	S___	K___	U___	O___
B___	S___	A___	C___	U___	K___	I___	O___	L___	S___	L___
C___	U___	O___	A___	B___	A___	K___	A___	B___	A___	B___
S___	K___	U___	B___	L___	B___	U___	K___	C___	B___	U___
L___	C___	L___	U___	A___	U___	B___	C___	A___	L___	K___
K___	A___	I___	S___	C___	I___	A___	B___	O___	C___	S___
I___	L___	K___	O___	I___	C___	O___	U___	I___	O___	C___
O___	I___	S___	L___	S___	L___	C___	I___	S___	I___	I___

ROUGHNESS DISCRIMINATION TEST (RDT)
SELF-SCORING ANSWER SHEET

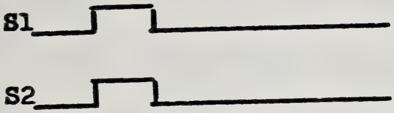
Name________________________ Date of Test____________ Score_____

Sample A 1 2 [✓ 3] 4

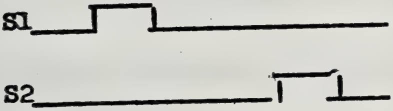
Sample B [✓ 1] 2 3 4

1. 1 2 [✓ 3] 4
2. 1 [✓ 2] 3 4
3. 1 [✓ 2] 3 4
4. 1 2 [✓ 3] 4
5. 1 2 [✓ 3] 4
6. 1 [✓ 2] 3 4
7. 1 2 [✓ 3] 4
8. 1 [✓ 2] 3 4
9. [✓ 1] 2 3 4
10. 1 2 [✓ 3] 4
11. 1 2 3 [✓ 4]
12. 1 2 3 [✓ 4]
13. 1 2 3 [✓ 4]
14. 1 [✓ 2] 3 4
15. 1 [✓ 2] 3 4
16. 1 2 [✓ 3] 4
17. 1 2 3 [✓ 4]
18. 1 [✓ 2] 3 4
19. [✓ 1] 2 3 4
20. 1 2 [✓ 3] 4
21. 1 [✓ 2] 3 4
22. 1 [✓ 2] 3 4
23. [✓ 1] 2 3 4
24. 1 [✓ 2] 3 4
25. 1 2 [✓ 3] 4
26. 1 2 [✓ 3] 4
27. 1 2 3 [✓ 4]
28. 1 2 3 [✓ 4]
29. 1 2 [✓ 3] 4
30. [✓ 1] 2 3 4
31. 1 2 3 [✓ 4]
32. 1 2 [✓ 3] 4
33. [✓ 1] 2 3 4
34. 1 [✓ 2] 3 4
35. 1 2 3 [✓ 4]
36. 1 2 3 [✓ 4]
37. 1 [✓ 2] 3 4
38. [✓ 1] 2 3 4
38. [✓ 1] 2 3 4
39. [✓ 1] 2 3 4
40. [✓ 1] 2 3 4
41. 1 [✓ 2] 3 4
42. 1 2 3 [✓ 4]
43. 1 2 [✓ 3] 4
44. 1 2 3 [✓ 4]
45. 1 [✓ 2] 3 4
46. 1 2 3 [✓ 4]
47. 1 [✓ 2] 3 4
48. [✓ 1] 2 3 4
49. 1 2 [✓ 3] 4
50. 1 2 3 [✓ 4]
52. 1 2 3 [✓ 4]
53. 1 2 [✓ 3] 4
54. [✓ 1] 2 3 4
55. 1 2 3 [✓ 4]
56. 1 2 [✓ 3] 4
57. [✓ 1] 2 3 4
58. 1 2 3 [✓ 4]
59. 1 2 [✓ 3] 4
60. [✓ 1] 2 3 4
61. 1 [✓ 2] 3 4
62. 1 2 [✓ 3] 4
63. 1 2 3 [✓ 4]
64. [✓ 1] 2 3 4
65. 1 2 3 [✓ 4]
66. [✓ 1] 2 3 4
67. 1 2 [✓ 3] 4
68. [✓ 1] 2 3 4
69. 1 2 [✓ 3] 4

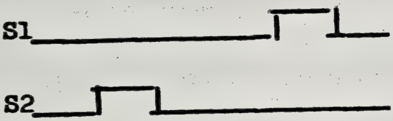
SCHEMATIC REPRESENTATION OF
GROUPS I, II, III, AND IV



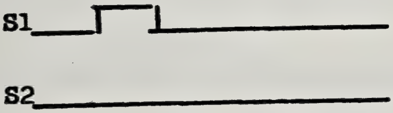
Group I



Group II



Group III



Group IV (Control)

S1: Raised Braille Character.
S2: Taped Explanation.

TAPED INSTRUCTIONS

Group I

You will experience the following events in this experiment for Phase I:

1. A raised Braille character will be presented to you for one-second duration. "Do not press down heavily with your finger on the oval space, nor make a circular motion. Touch each character gently and, if you wish to move your finger, go up and down, or across the character, but DO NOT move your finger around in a circle. You will be inclined to use pressure, but you will feel the dots more clearly if you touch them lightly [p. 1]" (Loomis, 1939).
2. At the same time and for the same duration as the Braille character is presented, you will hear the letter that it stands for.
3. The nine characters and their explanation will be presented in a random order for ten trials.
4. A second phase will follow these training trials and will allow for you to make a verbal response of identification before the tape gives you the correct answer.
5. Remember, the raised Braille character and a taped explanation will be presented to you at the same time and for the same duration.
6. With your finger in the proper position, so that it covers the whole oval space and is lightly resting on the space, we will now begin:

Group II

You will experience the following events in this experiment for Phase I:

1. A raised Braille character will be presented to you for one-second duration. Do not press down heavily with your finger on the oval space, nor make a circular motion. Touch each character gently and, if you wish to move your finger, go up and down, or across the character, DO NOT move your finger around in a circle. You will be inclined to use pressue, but you will feel

the dots more clearly if you touch them lightly.

2. Four seconds from the time you feel the Braille character, you will hear the letter of the alphabet that it stands for.

3. The nine characters and their explanation will be presented in a random order for ten trials.

4. A second phase will follow these training trials and will allow for you to make a verbal response of identification before the tape gives you the correct answer. This will be fully explained to you prior to beginning the second phase.

5. Remember, you will feel the raised Braille character first, and then four seconds later, will hear the letter of the alphabet that it stands for.

6. With your finger in the proper position, so that it covers the whole oval space and is lightly resting on the space, we will now begin:

Group III

You will experience the following events in this experiment for Phase I:

1. The tape recorder will present a particular letter of the alphabet to you. After a four-second delay, a raised Braille character, corresponding to that letter, will be presented to you for one-second duration. Do not press down heavily with your finger on the oval space, nor make a circular motion. Touch each character gently and, if you wish to move your finger, go up and down, or across the character, but DO NOT move your finger around in a circle. You will be inclined to use pressure, but you will feel the dots more clearly if you touch them lightly.

2. The taped explanation and the nine Braille characters will be presented to you in a random order for ten trials.

3. A second phase will follow these training trials and will allow for you to make a verbal response of identification before the tape gives you the correct answer. This will be fully explained to you before beginning the second phase.

4. Remember, you will hear the letter of the alphabet first and then, after a four-second delay, feel the raised Braille character corresponding to it.

5. With your finger in the proper position, so that it covers the whole oval space and is lightly resting on the space, we will now begin:

Group IV

You will experience the following events in this experiment:

1. A series of nine raised Braille characters will be presented to you, each for one-second duration. These characters stand for nine letters in the alphabet. There will be a six-second pause between each presentation. These nine Braille characters will be presented to you in a random order, for ten trials. Do not press down heavily with your finger on the oval space, nor make a circular motion. Touch each character gently and, if you wish to move your finger, go up and down, or across the character, but DO NOT move your finger around in a circle. You will be inclined to use pressure, but you will feel the dots more clearly if you touch them lightly.

2. A second phase will follow these familiarity trials and you will be asked to verbally respond with the correct letter before the tape recorder gives you the correct answer. This will be fully explained to you prior to beginning the second phase.

3. Remember, for this phase you will not be required to make any response, only feel the various characters as they are presented to you.

4. With your finger in the proper position, so that it covers the whole oval space and is lightly resting on the space, we will now begin.

All Groups

The following will occur in this experiment for

Phase II:

1. A raised Braille character will be again presented to you for one-second duration. From the beginning of its presentation and for a total of four seconds, you will be asked to make a verbal identification of this character. At the end of this four-second interval, the tape will give the correct answer. The examiner will write down your responses. You are encouraged to guess and at the end of the four-second interval, you will know if you are correct. This procedure will continue with a random order of presentation, until you have completed three errorless trials. That is, that you have correctly responded to the Braille character before the tape responds with the correct answer.

2. Again, with your finger in the proper position, so that it covers the whole oval space and is lightly resting on this space, we will begin.

APPENDIX B

SUPPLEMENTARY TABLES: DATA COLLECTED

TABLE 13

Number of Learning Trials to Criterion for Groups I, II, III, and IV

Group I	Group II	Group III	Group IV*
20	7	12	44
31	4	9	17
33	7	29	15
3	30	22	44
12	22	4	27
7	27	8	20
34	6	3	39
11	22	32	34
22	3	4	44
18	20	12	20
20	5	18	18
10	3	21	49
24	4	29	35
22	4	6	33
16	38	36	40

*Control group.

TABLE 14

Number of Relearning Trials to Criterion for Groups I, II, III, and IV

Group I	Group II	Group III	Group IV*
9	5	3	17
3	5	7	6
11	4	4	5
3	37	4	5
3	16	3	14
3	3	5	5
8	3	3	5
4	6	29	8
8	3	3	3
4	3	4	3
3	6	7	3
5	3	3	6
12	5	6	6
10	3	3	5
8	3	5	18

*Control group.

TABLE 15

Scores on the RDT for Groups I, II, III, and IV

Group I	Group II	Group III	Group IV*
63	50	58	58
64	66	60	69
59	69	63	69
69	56	51	69
58	53	61	51
63	64	62	55
63	61	66	55
62	65	59	63
61	66	65	56
52	48	65	56
62	63	66	55
58	64	66	57
60	55	56	67
62	69	65	58
57	63	62	62

*Control group.

TABLE 16

Scores on the AGCT for Groups I, II, III, IV

Group I	Group II	Group III	Group IV*
96	110	146	129
78	145	107	130
97	120	121	118
126	117	97	117
138	75	117	95
115	126	97	111
101	137	122	96
128	123	115	101
109	140	130	117
116	116	117	147
146	125	85	130
112	128	107	130
111	105	124	51
90	120	151	126
81	111	110	127

*Control group.

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